

REMARKS

The present invention relates to a method of forming a powder compact. Particularly it relates to a method of forming a powder compact which can produce a high density powder compact and at the same time can reduce pressure for ejecting a powder compact from a die.

As described in the specification under "Technical Background", beginning at [0002], the prior art has suggested various solutions to the problems associated with forming powder compacts under high compacting and ejecting pressure, including the use of lubricants such as metal stearates, but these solutions have been problematical.

As described in the specification at [0009], Applicants have discovered that as a result of study that when lithium stearate as a higher fatty acid lubricant is applied to an inner surface of a die, and iron powder heated to 150°C is charged into the die heated to the same temperature and compacted, contrary to expectations, ejecting pressure in the case of compaction with a compacting pressure of 686 MPa is smaller than that in the case of compaction with a compacting pressure of 588 MPa, which discovery disproves an established theory that when powder is formed into a compact under a high pressure, high pressure is necessary to eject this compact; and further, that iron stearate adheres to a surface of a compact which has been produced by applying lithium stearate to an inner die surface and compacting iron powder with a compacting pressure of 981 MPa. Applicants observed a similar phenomenon using other lubricants and other temperatures [0010]. As described in [0011], Applicants made various assumptions, resulting in the presently-claimed method.

Thus, in above-amended Claim 1, for example, the invention is a method of forming a powder compact comprising: applying a higher fatty acid lubricant which is dispersed into water containing a surfactant to an inner surface of a heated die which is heated to the melting point or less of said higher fatty acid lubricant; and filling metal powder into said die and compacting said metal powder under such a pressure that said higher fatty acid lubricant

is chemically bonded with said metal powder to form a metallic soap coating which is different from said higher fatty acid lubricant.

The rejection of Claims 1-4, 7, 9, 10, 14 and 15 under 35 U.S.C. § 102(b) as anticipated by JP 9-272901 (Harada et al), is respectfully traversed. Harada et al discloses a powder molding method in which a molding die and molding powder are heated to within a temperature range of 150-400°C, and at the same time, die surfaces of the molding die are coated with a lubricant. The heated molding powder is filled in the molding cavity of the heated molding die, and the molding powder is then compression-molded to form a green compact [0007]. Harada et al recognizes no relationship between the maximum temperature of the heated die and the melting point of their lubricant, beyond simply specifying that the die is heated to a temperature range of 150-400°C. Nor does Harada et al recognize the formation of a metallic soap coating which is different from their lubricant. Indeed, the rejection is now moot since Claim 1 contains the limitations of Claim 8 not subject to any rejections over Harada et al.

For all the above reasons, it is respectfully requested that this rejection be withdrawn.

The rejection of Claims 5 and 6 under 35 U.S.C. § 103(a) as unpatentable over Harada et al in view of U.S. 5,191,098 (Koenig et al) and CA 2,156,872 (Inculet et al), is respectfully traversed. In this rejection, the Examiner relies on Koenig et al for a disclosure of surfactants as dispersing agents and lubricant particle sizes; the Examiner relies on Inculet et al for a disclosure of lubricant particle sizes. However, even if these disclosures were applied to Harada et al, they would not remedy the above-discussed deficiencies thereof. Accordingly, it is respectfully requested that this rejection be withdrawn.

The rejections under 35 U.S.C. § 103(a) of Claims 1-3 and 7-23 over Inculet et al in view of U.S. 6,190,605 (Cadle et al), and of Claims 4-6 over Inculet et al in view of Cadle et al, and further in view of Koenig et al, are respectfully traversed.

Inculet et al discloses a method of forming a powder compact comprising applying a higher fatty acid lubricant to an inner surface of the heated die, filling the die with metal powder and compacting the powder under pressure (page 3, lines 25-36). Inculet et al further discloses that the die cavity and the metal powder may be preheated to a high temperature of up to 700°F prior to the compacting step (page 5, lines 4-7).

Cadle et al discloses a method of compacting metal powder in a compaction mold which involves controlling the surface temperature of the walls of the mold to between a softening temperature and a melting temperature of a lubricant, and then applying the lubricant to the walls, after which powder metal is charged into the mold, the metal contacting the lubricant applied to the walls, and then the powder is compacted while maintaining the surface temperature of the walls of the mold between the above-discussed temperature range (column 4, lines 12-26).

Koenig et al has been discussed above.

The Examiner holds that it would have been obvious to heat the die of Inculet et al to a temperature less than the melting point of the lubricant in view of Cadle et al. However, if one skilled in the art combined Inculet et al and Cadle et al, the result would not be the presently-claimed invention. If these references were combined, Inculet et al's method would be carried out by applying the lubricant *per se* to the inner surface of the die heated to a temperature between a softening temperature and a melting temperature of the lubricant. Nor does the combination of these references suggest compacting under such a pressure that the lubricant is chemically bonded with the metal powder to form a metallic soap coating which is different from the lubricant. Koenig et al does not remedy the above-discussed deficiencies in the combination of Inculet et al and Cadle et al, for reasons discussed above.

For all the above reasons, it is respectfully requested that these rejections be withdrawn.

The rejections under 35 U.S.C. § 103(a) of Claims 1-3 and 7-22 as unpatentable over U.S. 6,344,169 (Tsuchida et al) in view of Cadle et al, and of Claims 4-6 and 23 as unpatentable over Tsuchida et al in view of Cadle et al, and further in view of Koenig et al and Inculet et al, are respectfully traversed.

Tsuchida et al discloses deficiencies in the method of Harada et al (column 2, lines 18-32), and is directed to a method for compaction of powders for powder metallurgy which overcomes the problems of prior art such as Harada et al (column 2, lines 36-39), which method involves using powders containing a lubricant in an amount of 0.2 wt.% or below but non-inclusive of 0 wt.% (column 2, lines 46-55). However, in Tsuchida et al's method, the compacting temperature is **higher** than the melting point of the lubricant (column 4, lines 58-66) and Tsuchida et al discloses disadvantages in compacting at a temperature below the melting point of the lubricant (column 5, line 1 ff). Thus, Tsuchida et al actually teach away from the presently-claimed invention. Indeed, when the temperature of the die is heated to a temperature higher than the melting point of the lubricant, the lubricant drops down along an inner surface of the die and as a result, a metallic soap coating is not uniformly formed on the inner surface of the die, and it is impossible to decrease the ejecting pressure and to prevent damage of the die. Moreover, one skilled in the art would not combine Tsuchida et al and Cadle et al, because their respective disclosures of temperature are mutually exclusive and inconsistent. The remaining prior art does not overcome these deficiencies.

For all the above reasons, it is respectfully requested that these rejections be withdrawn.

Applicants respectfully call the Examiner's attention to the Information Disclosure Statements (IDSs) filed April 13, 2004 and November 22, 2002, and that a decision has never been entered on the Petition filed May 12, 2003 regarding reference "AW". **Submitted herewith** is another copy of the Forms PTO-1449 submitted with the above-referenced IDSs,

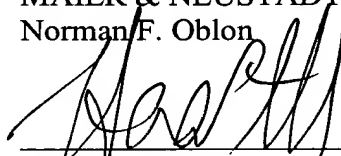
said Petition, and said reference AW. The Examiner is respectfully requested to initial the PTO-1449 forms, and include a copy thereof with the next Office communication.

Moreover, since the dates of the IDSs are before the date of the Office Action and thus technically were part of the Official file as of the Office Action date, Applicants respectfully request that should the Examiner determine that a new ground of rejection needs to be made in the next Office Action relying in whole or in part on any of the references cited in the IDSs, then said next Office Action not be made Final, even if the new rejection was necessitated by the present amendment to the claims.

All of the presently-pending claims in this application are now believed to be in immediate condition for allowance. Accordingly, the Examiner is respectfully requested to pass this application to issue.

Respectfully submitted,

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